# Table of Contents

Preface.................................................................................................................................................. xxii

**Volume I**

**Section 1**

**Fundamental Concepts and Theories**

This section serves as a foundation for this exhaustive reference tool by addressing underlying principles essential to the understanding of Renewable and Alternative Energy. Insight regarding the critical incorporation of global measures into Renewable and Alternative Energy is addressed, while crucial stumbling blocks of this field are explored. With 12 chapters comprising this foundational section, the reader can learn and choose from a compendium of expert research on the elemental theories underscoring the Renewable and Alternative Energy discipline.

**Chapter 1**

An Overview to Thermal Solar Systems for Low Temperature: Outlining the European Norm 12976

*Vicente González-Prida, University of Seville, Spain*

*Anthony Raman, NTEC Tertiary Group, New Zealand*

**Chapter 2**

A Road Map for a Domestic Wind Turbine Manufacturing Industry in Turkey

*M. Mustafa Erdoğan, Marmara University, Turkey*

*Coskun Karaca, Cumhuriyet University, Turkey*

**Chapter 3**

Undergraduate and Postgraduate Education in Renewable Energy

*Richard Corkish, University of New South Wales, Australia*

**Chapter 4**

Cold Thermal Energy Storage

*Franc Franc Kosi, University of Belgrade, Serbia*

*Branislav Zivkovic, University of Belgrade, Serbia*

*Mirko S. Komatina, University of Belgrade, Serbia*

*Dragi Antonijevic, Singidunum University, Belgrade, Serbia*

*Mohamed Abdul Galil, University of Belgrade, Serbia*

*Uros Milorad Milovancevic, University of Belgrade, Serbia*
Chapter 5
A Reliability Test Installation for Water Heating Solar Systems: Requirements and Design
According to the European Norm 12976

Vicente González-Prida, University of Seville, Spain
Anthony Raman, NTEC Tertiary Group, New Zealand

Chapter 6
Optical Nano-Antennas for Energy Harvesting

Salah Obayya, Zewail City of Science and Technology, Egypt
Nihal Fayez Fahmy Areed, Zewail City of Science and Technology, Egypt & Mansoura University, Egypt
Mohamed Farhat O. Hameed, Zewail City of Science and Technology, Egypt & Mansoura University, Egypt
Mohamed Hussein Abdelrazik, Zewail City of Science and Technology, Egypt & Ain Shams University, Egypt

Chapter 7
A Review of Various Nanostructures to Enhance the Efficiency of Solar-Photon-Conversions

S. A. Akhoon, National Institute of Technology, Srinagar, India
S. Rubab, National Institute of Technology, Srinagar, India
M. A. Shah, National Institute of Technology, Srinagar, India

Chapter 8
Knowledge Assets Management in the Energy Industry: A Systematic Literature Review

Antonio Lerro, University of Roma 3, Italy
Giovanni Schiuma, University of the Arts London, UK
Francesca A. Jacobone, University of Roma 3, Italy

Chapter 9
Greenhouse Gas Mitigation through Energy Efficiency: Perform, Achieve, and Trade (PAT) – India’s Emission Trading Scheme

Ali Reja Osmani, Karimganj Law College, India

Chapter 10
Bondonic Electrochemistry: Basic Concepts and Sustainable Prospects

Mihai V. Putz, West University of Timişoara, Romania & Research and Development National Institute for Electrochemistry and Condensed Matter (INCEMC) Timişoara, Romania
Marina A. Tudoran, West University of Timişoara, Romania & Research and Development National Institute for Electrochemistry and Condensed Matter (INCEMC) Timişoara, Romania
Marius C. Mirica, Research and Development National Institute for Electrochemistry and Condensed Matter (INCEMC) Timişoara, Romania
Chapter 11
Solar Power Plant Optimization.......................... 360
Carlos Sanchez Reinoso, Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Argentina & National University of San Juan (UNSJ), Argentina
Román Buitrago, Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Argentina & UNL-CONICET, Argentina
Diego Milone, UNL-CONICET, Argentina

Chapter 12
Solar Energy Potential as Support for Sustainable Development of Romanian Economy .............. 386
Dorel Dusmanescu, Petroleum-Gas University of Ploiesti, Romania

Section 2
Development and Design Methodologies

This section contains 11 chapters providing an in-depth coverage of conceptual architecture frameworks to provide the reader with a comprehensive understanding of the emerging developments within the field of Renewable and Alternative Energy. Research fundamentals imperative to the understanding of developmental processes within Renewable and Alternative Energy are offered. From broad examinations to specific discussions on methodology, to basic designs to abstract development, these chapters serve to expand the reaches of development and design technologies within the Renewable and Alternative Energy community.

Chapter 13
Sustainable Design of Photovoltaics: Devices and Quantum Information .............................. 416
Mihai V. Putz, West University of Timişoara, Romania & Research and Development National Institute for Electrochemistry and Condensed Matter (INCEMC) Timişoara, Romania
Marina A. Tudoran, West University of Timişoara, Romania & Research and Development National Institute for Electrochemistry and Condensed Matter (INCEMC) Timişoara, Romania
Marius C. Mirica, Research and Development National Institute for Electrochemistry and Condensed Matter (INCEMC) Timişoara, Romania
Mirela I. Iorga, Research and Development National Institute for Electrochemistry and Condensed Matter (INCEMC) Timişoara, Romania
Radu Bănică, Research and Development National Institute for Electrochemistry and Condensed Matter (INCEMC) Timişoara, Romania
Ştefan D. Novaconi, Research and Development National Institute for Electrochemistry and Condensed Matter (INCEMC) Timişoara, Romania
Ionel Balcu, Research and Development National Institute for Electrochemistry and Condensed Matter (INCEMC) Timişoara, Romania
Ştefania F. Rus, Research and Development National Institute for Electrochemistry and Condensed Matter (INCEMC) Timişoara, Romania
Ana-Maria Putz, Institute of Chemistry Timişoara of Romanian Academy, Romania & West University of Timişoara, Romania
Chapter 14
Sustainable Development and Turkey’s Biomass Energy Potential

Coşkun Karaca, Cumhuriyet University, Turkey
M. Mustafa Erdoğan, Marmara University, Turkey

Chapter 15
Fuzzy Logic in Wind Energy

Imanol López Goiti, University of the Basque Country, Spain

Chapter 16
Modeling and Simulation of a Stand-Alone Hydrogen Photovoltaic Fuel Cell Hybrid System

M.T. Benmessaoud, University of Science and Technology of Oran, Algeria
A. Boudghene Stambouli, University of Science and Technology of Oran, Algeria
M. Tioursi, University of Science and Technology of Oran, Algeria

Chapter 17
Mechatronic System Design for a Solar Tracker

H. Henry Zhang, Purdue University, USA
Li-Zhe Tan, Purdue University North Central, USA
Wangling Yu, Purdue University North Central, USA
Simo Meskouri, Chrysler Technology Center, USA

Chapter 18
Electricity Production from Small-Scale Photovoltaics in Urban Areas

Constantinos S. Psomopoulos, Piraeus University of Applied Sciences (TEI of Piraeus), Greece
George Ch. Ioannidis, Piraeus University of Applied Sciences (TEI of Piraeus), Greece
Stavros D. Kaminaris, Piraeus University of Applied Sciences (TEI of Piraeus), Greece

Volume II

Chapter 19
Design and Implementation of a Fuzzy Inference Model for Mapping the Sustainability of Energy Crops

Fausto Cavallaro, University of Molise Via De Sanctis, Italy
Luigi Ciraolo, University of Messina, Italy

Chapter 20

Elias Yaacoub, Strategic Decisions Group (SDG), Lebanon & Arab Open University (AOU), Lebanon
Hakim Ghazzai, Qatar Mobility Innovations Center (QMIC), Qatar
Mohamed-Slim Alouini, King Abdullah University of Science and Technology (KAUST), Saudi Arabia
**Chapter 21**
Intelligent Bidding in Smart Electricity Markets ................................................................. 712
*Magda Foti, University of Thessaly, Greece*
*Manolis Vavalis, University of Thessaly, Greece*

**Chapter 22**
Modeling and Operating Strategies of Micro-Grids for Renewable Energy Communities .......... 735
*Saad Salman Khan, IQRA National University Peshawar, Pakistan*

**Chapter 23**
Automatic Generation Control of Thermal-Thermal-Hydro Power Systems with PID Controller Using Ant Colony Optimization ........................................................................................................ 761
*Jagatheesan Kaliannan, Mahendra Institute of Engineering and Technology, India*
*Anand Baskaran, Hindusthan College of Engineering and Technology, India*
*Nilanjan Dey, Jadavpur University, India*

**Section 3**
Tools and Technologies

This section presents an extensive coverage of various tools and technologies available in the field of Renewable and Alternative Energy that practitioners and academicians alike can utilize to develop different techniques. These chapters enlighten readers about fundamental research on the many tools facilitating the burgeoning field of Renewable and Alternative Energy. It is through these rigorously researched chapters that the reader is provided with countless examples of the up-and-coming tools and technologies emerging from the field of Renewable and Alternative Energy. With 13 chapters, this section offers a broad treatment of some of the many tools and technologies within the Renewable and Alternative Energy field.

**Chapter 24**
*L. V. Massel, Energy Systems Institute, Siberian Branch of the Russian Academy of Sciences, Russia*
*V. L. Arshinsky, Energy Systems Institute, Siberian Branch of the Russian Academy of Sciences, Russia*
*A. G. Massel, Energy Systems Institute, Siberian Branch of the Russian Academy of Sciences, Russia*

**Chapter 25**
Systems with Concentrating Solar Radiation .................................................................................. 788
*Saša R. Pavlović, University of Niš, Serbia*
*Velimir P. Stefanović, University of Niš, Serbia*
Chapter 26
A Novel Mixed Integer Programming Formulation for Selecting the Best Renewable Energies to Invest: A Fuzzy Goal Programming Approach ................................................................. 857
  Masoud Rabbani, University of Tehran, Iran
  Mahsa Ghanbarpour Mamaghani, University of Tehran, Iran
  Amir Farshbaf-Geranmayeh, University of Tehran, Iran
  Mahsa Mirzayi, University of Tehran, Iran

Chapter 27
Application of Mathematical Modeling for the Secure and Intelligent Energy Infrastructure .......... 879
  Tianxing Cai, Lamar University, USA

Chapter 28
Application of Clean Development Mechanism (CDM) in Renewable Energy Generation from Micro-Hydel Projects of Himachal Pradesh ................................................................. 886
  A. N. Sarkar, Asia-Pacific Institute of Management, India

Chapter 29
In2X3 (X=S, Se, Te) Semiconductor Thin Films: Fabrication, Properties, and Applications ............ 914
  Mahieddine Emziane, Masdar Institute of Science and Technology, UAE
  Rahana Yoosuf, Masdar Institute of Science and Technology, UAE

Chapter 30
Adoption of Biomass Heating Systems: Cross-Market Segmentation of the European Region .......... 959
  Inmaculada García-Maroto, University of Granada, Spain
  Francisco Muñoz-Leiva, University of Granada, Spain

Chapter 31
Applications of Vibration-Based Energy Harvesting (VEH) Devices ........................................... 989
  Ooi Beng Lee, Quest International University Perak, Malaysia
  Thein Chung Ket, Taylor’s University, Malaysia
  Yew Chun Keat, University of Hull, UK
  A. Rashid A. Aziz, Universiti Teknologi Petronas, Malaysia

Chapter 32
Decreasing Wear of Large Vertical Axis Wind Turbines by Employing a Multi-Level Turbine Concept .................................................................................................................. 1015
  Jan H. Wiśniewski, Warsaw University of Technology, Poland

Chapter 33
Energy Harvesting and Energy Conversion Devices Using Thermoelectric Materials .................. 1029
  Mihail O. Cernaianu, Horia Hulubei National Institute of Physics and Nuclear Engineering (IFIN-HH), Romania
  Aurel Gontean, “Politehnica” University Timisoara, Romania
Section 4
Utilization and Applications

This section discusses a variety of applications and opportunities available that can be considered by practitioners in developing viable and effective Renewable and Alternative Energy programs and processes. This section includes 12 chapters that review topics from case studies to best practices and ongoing research. Further chapters discuss Renewable and Alternative Energy in a variety of settings. Contributions included in this section provide excellent coverage of today’s IT community and how research into Renewable and Alternative Energy is impacting the social fabric of our present-day global village.

Chapter 37
Use of Hydrogen and Fuel Cells for Refrigerated Transport ................................................................. 1146
   Raquel Garde, National Renewable Energy Centre (CENER), Spain
   Sindia Casado, National Renewable Energy Centre (CENER), Spain
   Fernando Jimenez, National Renewable Energy Centre (CENER), Spain
   Gabriel Garcia-Naveda, National Renewable Energy Centre (CENER), Spain
   Monica Aguado, National Renewable Energy Centre (CENER), Spain

Chapter 38
Dynamic Particle Swarm Optimization with Any Irregular Initial Small-World Topology ............. 1185
   Shuangxin Wang, Beijing Jiaotong University, China
   Guibin Tian, Beijing Jiaotong University, China
   Dingli Yu, Liverpool John Moores University, UK
   Yijiang Lin, Beijing Jiaotong University, China

Chapter 39
A System Safety Analysis of Renewable Energy Sources ................................................................. 1209
   Warren Naylor, Independent Researcher, USA
Chapter 40
Implementing a Fuzzy Logic Based Algorithm to Predict Solar and Wind Energies in a Hybrid Renewable Energy System

Sanaa Faquir, Sidi Mohamed Ben Abdellah University, Morocco
Ali Yahyaoui, Sidi Mohamed Ben Abdellah University, Morocco
Hamid Tairi, Sidi Mohamed Ben Abdellah University, Morocco
Jalal Sabor, ENSAM-MEKNES, Morocco

Chapter 41
Assessing the Profitability of Changing a Turbine for a Hydroelectric Power Plant Based on Long-Period Water Gauge Readings

Jan H. Wiśniewski, Warsaw University of Technology, Poland
Bartosz M. Olszański, Warsaw University of Technology, Poland

Chapter 42
Using Fuzzy Control Methods for Increasing the Energy Efficiency of Buildings

Vassiliki Mpelogianni, University of Patras, Greece
Peter Groumpos, University of Patras, Greece

Chapter 43
Signal Processing Techniques in Smart Grids

Zahoor Uddin, COMSATS Institute of Information Technology, Pakistan
Nadir Shah, COMSATS Institute of Information Technology, Pakistan
Ayaz Ahmad, COMSATS Institute of Information Technology, Pakistan
Waqar Mehmood, COMSATS Institute of Information Technology, Pakistan
Farooq Alam, COMSATS Institute of Information Technology, Pakistan

Chapter 44
Revising the Empirical Linkage between Renewable Energy Consumption and Economic Growth in Tunisia: Evidence from ARDL Model

Sekrafi Habib, University of Sousse, Tunisia

Volume III

Chapter 45
The Topicality and the Peculiarities of the Renewable Energy Sources Integration into the Ukrainian Power Grids and the Heating System

Vira Shendryk, Sumy State University, Ukraine
Olha Shulyma, Sumy State University, Ukraine
Yuliia Parfenenko, Sumy State University, Ukraine

Chapter 46
Impact of Green Growth and Development Path for Skilled and Unskilled Job Creation and Economic, Social Sustainability: Case Study of India – A Recursive Dynamic CGE Model Approach

Anandajit Goswami, The Energy and Resources Institute (TERI), India
Saswata Chaudhury, The Energy and Resources Institute (TERI), India
Tarun Garg, The Energy and Resources Institute (TERI), India
Chapter 47
Feasibility of Implementation of Solar Bottle Bulb in Urban Slums of India
Akshay Maggu, Institute of Management Technology Ghaziabad, India
Jaideep Garg, Institute of Management Technology Ghaziabad, India

Chapter 48
Evaluation of Renewable Energy Alternatives Using Hesitant Fuzzy TOPSIS and Interval Type-2 Fuzzy AHP
Başar Öztayşi, Istanbul Technical University, Turkey
Cengiz Kahraman, Istanbul Technical University, Turkey

Section 5
Critical Issues and Challenges
This section contains 11 chapters, giving a wide variety of perspectives on Renewable and Alternative Energy and its implications. Within the chapters, the reader is presented with an in-depth analysis of the most current and relevant issues within this growing field of study. Crucial questions are addressed and alternatives offered along with theoretical approaches discussed.

Chapter 49
Low Carbon Footprint: The Supply Chain Agenda in Malaysian Manufacturing Firms
Muhammad Shabir Shaharudin, Universiti Sains Malaysia, Malaysia
Yudi Fernando, Universiti Sains Malaysia, Malaysia

Chapter 50
Optimal Operational Strategy for PV/Wind-Diesel Hybrid Power Generation System with Energy Storage
Vincent Anayochukwu Ani, University of Nigeria, Nsukka, Nigeria

Chapter 51
Energy Sustainability of Countries
Evangelos Grigoroudis, Technical University of Crete, Greece
Vassilis S. Kouikoglou, Technical University of Crete, Greece
Yannis A. Phillis, Technical University of Crete, Greece

Chapter 52
Optimization of Small Wind Turbines Using Genetic Algorithms
Mohammad Hamdan, Yarmouk University, Jordan
Mohammad Hassan Abderrazzaq, Yarmouk University, Jordan

Chapter 53
Energy Management Strategies to Improve Electrical Networks Using Storage Systems
Juan Aurelio Montero-Sousa, University of A Coruña, Spain
Luis Alfonso Fernández-Serantes, University of A Coruña, Spain
José-Luis Casteleiro-Roca, University of A Coruña, Spain
Xosé Manuel Vilar-Martínez, University of A Coruña, Spain
Jose Luis Calvo-Rolle, University of A Coruña, Spain
Chapter 54
Quantifying the Uncertainty of Energy Creation from Solar and Wind Farms in Different Locations
Roy Nersesian, Monmouth University, USA
Kenneth David Strang, State University of New York, Queensbury, USA & APPC Research Australia, Australia

Chapter 55
An Accurate and Efficient Analytical Method to Extract the Parameters of the Single and Double Diode Photovoltaic Cells Models
Radouane Majdoul, Hassan 1st University, Morocco
Elhassane Abdelmounim, Hassan 1st University, Morocco
Mohamed Aboulfatah, Hassan 1st University, Morocco
Abd Elwahed Touati, Hassan 1st University, Morocco
Ahmed Moutabir, Hassan 1st University, Morocco

Chapter 56
An Integrated Approach for Sustainable Environmental and Socio-Economic Development Using Offshore Infrastructure
Phoebe Koundouri, Athens University of Economics and Business, Greece & London School of Economics, UK & International Centre for Research on the Environment and the Economy, Greece
Amerissa Giannouli, Athens University of Economics and Business, Greece & International Centre for Research on the Environment and the Economy, Greece
Ioannis Souliotis, Centre for Environmental Policy, Imperial College London, UK & International Centre for Research on the Environment and the Economy, Greece

Chapter 57
Tackling Climate Change through Educational Awareness: A Case Study on Georgia House Resolution 689
Karla Drenner, Kaplan University, USA

Chapter 58
Energy and Exergy Analysis on Gasification Processes: A Preliminary Approach
Edgardo Olivares Gómez, Brazilian Center for Research in Energy and Materials (CNPEM), Brazil
Renato Cruz Neves, Brazilian Center for Research in Energy and Materials (CNPEM), Brazil
Elisa Magalhães de Medeiros, University of Campinas, Brazil
Mylene Cristina Alves Ferreira Rezende, Brazilian Center for Research in Energy and Materials (CNPEM), Brazil

Chapter 59
Hybrid Supply Chain Strategies in Wind Business
Jordi Castelló, Universitat de Girona, Spain
Rodolfo de Castro, Universitat de Girona, Spain
Andrea Bikfalvi, Universitat de Girona, Spain
Section 6
Emerging Trends

This section includes 11 chapters highlighting research potential within the field of Renewable and Alternative Energy while exploring uncharted areas of study for the advancement of the discipline. Chapters in this section explain future research directions and topical suggestions for continued debate, centering on the new venues and forums for discussion. The book concludes with a look into the future of the Renewable and Alternative Energy field. In all, this text will serve as a vital resource to practitioners and academics interested in the best practices and applications of the burgeoning field of Renewable and Alternative Energy.

Chapter 60
Revolution of Energy Storage System in Smart Grids
Jianhui Wong, Universiti Tunku Abdul Rahman, Malaysia
Yun Seng Lim, Universiti Tunku Abdul Rahman, Malaysia

Chapter 61
A New Robust H∞ Control Power
Samir Abdelmalek, Unité de Développement des Equipements Solaires (UDES), Centre de Développement des Energies Renouvelables (CDER), Algeria
Hocine Belmili, Unité de Développement des Equipements Solaires (UDES), Centre de Développement des Energies Renouvelables (CDER), Algeria

Chapter 62
Imran Shakir, Sungkyunkwan University, Korea & King Saud University, Saudi Arabia
Zahid Ali, Sungkyunkwan University, Korea
Usman Ali Rana, King Saud University, Saudi Arabia
Ayman Nafady, King Saud University, Saudi Arabia
Mansoor Sarfraz, King Saud University, Saudi Arabia
InasMuen Al-Nashef, King Saud University, Saudi Arabia
Rafaqat Hussain, Universiti Teknologi Malaysia, Malaysia
DaeJoon Kang, Sungkyunkwan University, Korea

Chapter 63
Silver Coatings with Protective Transparent Films for Solar Concentrators
Monserrat Gutiérrez Muñoz, CIDETEQ, S.C., Mexico
Jose de Jesus Perez Bueno, CIDETEQ, S.C., Mexico
Ernesto González De León, Instituto Tecnológico de Tepic, Mexico
Yunny Meas, CIDETEQ, S.C., Mexico
Guy Stremsdoerfer, Ecole Centrale de Lyon, France

Chapter 64
Electronic and ICT Solutions for Smart Buildings and Urban Areas
Luca Tamburini, University of Trento, Italy
Maurizio Rossi, University of Trento, Italy
Davide Brunelli, University of Trento, Italy
Chapter 65
Quantum Dots Searching for Bondots: Towards Sustainable Sensitized Solar Cells....................... 1805
Mihai V. Putz, West University of Timișoara, Romania & Research and Development
National Institute for Electrochemistry and Condensed Matter (INCEMC) Timişoara, Romania
Marina A. Tudoran, West University of Timișoara, Romania & Research and Development
National Institute for Electrochemistry and Condensed Matter (INCEMC) Timişoara, Romania
Marius C. Mirica, Research and Development National Institute for Electrochemistry and
Condensed Matter (INCEMC) Timişoara, Romania

Chapter 66
Earth Long-Wave Infrared Emission, New Ways to Harvest Energy ........................................... 1875
Luciano Mescia, Politecnico di Bari, Italy
Pietro Bia, Politecnico di Bari, Italy
Onofrio Losito, Politecnico di Bari, Italy

Chapter 67
Current and Future Trends of Refrigerants Development............................................................. 1900
M. V. Duarte, University of Beira Interior, Portugal
L. C. Pires, University of Beira Interior, Portugal
P. D. Silva, University of Beira Interior, Portugal
P. D. Gaspar, University of Beira Interior, Portugal

Chapter 68
Smart Homes and Sustainable Energy in Nigeria........................................................................... 1952
Oluwasola Oni, Pan-Atlantic University, Nigeria

Chapter 69
Solar Micro Grids: Impact and Future in Rural Uttar Pradesh – Case Study on MGP ............... 1971
Rahul Singh, IMT Ghaziabad, India
Anirban Sharma, IMT Ghaziabad, India
Amanpreet Kaur, IMT Ghaziabad, India
Mansi Gupta, IMT Ghaziabad, India
Kannan TS, IMT Ghaziabad, India

Chapter 70
Creative Energy Alternatives: Cheap and Clean Future Energy for Turkey.......................... 1984
Esin Okay, Istanbul Commerce University, Turkey

Index.............................................................................................................................................. xxiii